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STUDIES IN FRUIT-DISEASES

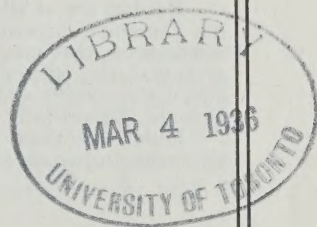
APPLE SCAB

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DOMINION OF CANADA  
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# DOMINION PLANT PATHOLOGICAL LABORATORIES

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Readers are at all times requested to make full use of the plant pathological service of the Dominion Experimental Farms. Assistance is given individuals through personal correspondence, that may be addressed to the Dominion Botanist, Central Experimental Farm, or any of the officers in charge of the Field Laboratories noted above. For advice on destructive insects and pests, communications should be addressed to the Dominion Entomologist, Department of Agriculture, Ottawa.

Letters addressed to the Dominion Botanist at Ottawa may be sent free by mail; also specimens in parcels not exceeding twelve ounces in weight.

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## APPLE SCAB

The most widely distributed and destructive disease of the apple with which the Canadian orchardist has to contend is undoubtedly scab or black spot. Practically every year some orchard sections in the Dominion are severely affected and the crops more or less seriously reduced in commercial value. Estimates of the actual loss caused by apple scab are not available for the entire Dominion. The losses experienced by one province alone may illustrate the economic importance of this disease. The year 1925 was one of the worst "scab" years in the history of the apple industry in Nova Scotia. Estimates of the actual financial loss to the growers of that province place the minimum at \$750,000, an amount sufficient to pay the total cost of spray and dust materials used in Nova Scotia for a period of six years. The 1926 crop in the same province was less than half of a normal yield. This reduction in yield can be partially attributed to a lessened vigour in the trees due to the heavy infestation of scab the previous year. Without considering this factor as part of the estimate, the actual loss from scab to growers in Nova Scotia during 1926 was placed at \$400,000. Unsprayed orchards caused a loss to the owners of approximately \$200 per acre in both seasons.

This pamphlet has been prepared for the purpose of directing attention to certain fundamental phases in the life-history of the disease in the hope that a better understanding of these phases will lead to the more efficient application of control measures.

### DESCRIPTION OF THE DISEASE

The scab spots on the fruit (fig. 1) are so well known to the majority of orchardists as to require little description. They are most prevalent during the early part of the season, at the calyx end of the fruit, but towards harvest time may be found on any part of the fruit. The characteristic feature of the young spot on the fruit is the torn or ruptured cuticle bordering the dark spot. The spots frequently enlarge and unite, thus forming extensive scab areas, and in such cases cause a dwarfing or cracking of the fruit.

Apple scab on the foliage may be of two forms—primary and secondary. The primary form of the disease is found on the under surface of the leaves early in the season (fig. 2). These spots are infections resulting from the spores formed in the over-wintering leaves on the ground. Later in the season the secondary form develops, usually on the upper surface of the foliage in mould-like patches (fig. 3). Primary and secondary infections are similar in appearance. The areas are dark olivaceous or brown in colour, of indefinite form, and frequently cause a puckering of the leaf surface.

The blossoms and blossom stems, as well as the calyces, are also susceptible to infection, and it is not uncommon to find the disease causing a heavy drop of blossoms and young fruit. The lesions or scab areas on the flower parts are not as conspicuous as those on the leaves. They are lighter in colour and sparse, but eventually will completely girdle the affected part.

The twigs of very susceptible varieties of apples may also be affected with scab. Infection of the twigs takes place when they are still quite green and succulent. The disease appears as small round lesions seldom over one-eighth of an inch in diameter, and is most noticeable in the fall of the year. These twig lesions may serve not only as sources of spreading scab infection, by the spores they produce, but may also be the centres by which canker-producing fungi gain entrance to the wood.



## CAUSE OF THE DISEASE

Apple scab is caused by a fungus named *Venturia inaequalis* (Cke.) Wint. The fungus has a rather interesting life-history, and in order to combat the disease effectively, it is necessary to know all about the fungus, and how it spreads its damaging influence in the orchard.

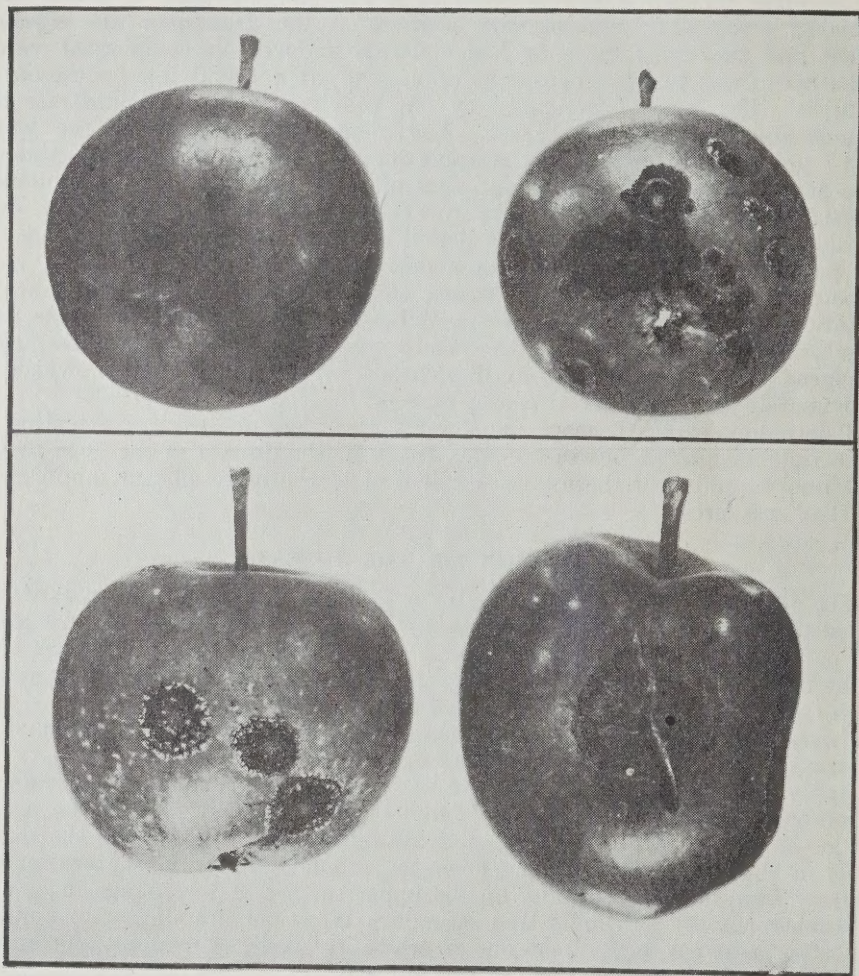


FIG. 1—Apple scab on fruit. Note the fringed border (cuticle) on the newer spots and the cracking of the old spot.

This fungus spends the winter in the fallen apple leaves. During the autumn and early spring it develops fruiting bodies which may be seen with the aid of a pocket lens, in the form of small, black specks, scattered, or in small clusters, breaking through the top layer of the leaf tissue. In the spring, about the time the leaf buds and flower buds on the trees are commencing to swell, these small bodies, called perithecia, enlarge and gradually become filled with a large number of sacs of spores. Several hundred spores may be in each perithecium. During wet days, following the time these spores, called ascospores, have matured, they are discharged into the air and carried by air currents to the



trees. These ejections continue intermittently on wet days for six or eight weeks, and sometimes longer. The first discharge of ascospores usually takes place about the time the trees are in the "green tip" or "mouse-ear" stage of development. The heaviest ascospore discharges occur, as a rule, when the trees are in full bloom, or dropping their petals. These spores may infect any of the new growth on the tree and cause the primary infections. When the spores alight on the wet leaves they germinate and the fungus growth finds its way under the outermost layer of leaf tissue. Here it develops, until, in about ten or fourteen days, an olivaceous velvet-like growth is visible to the naked eye.

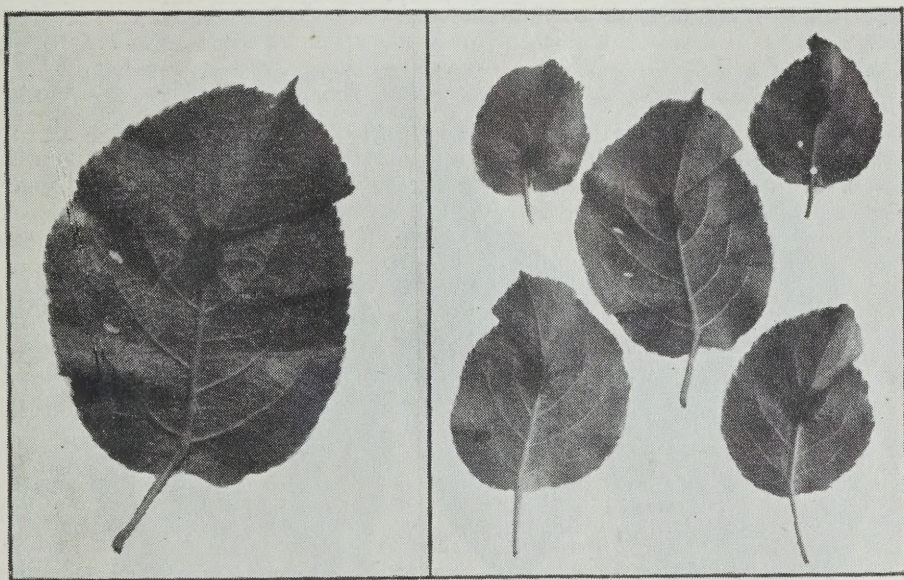


FIG. 2—Under surfaces of leaves showing primary infections of apple scab caused by the ascospores.

The primary infections from ascospores eventually give rise to a new type of spore, collectively called conidia, which will spread infection to any susceptible and unprotected part of the tree during favourable weather conditions throughout the season. Moisture on the leaves and temperatures from 50° to 70° for a period of six to ten hours are most favourable for fungus development.

The conidiospores which are formed on the twig lesions may cause leaf infections in the early spring.

The study of the development of the fungus in the old leaves and subsequent ascospore discharges forms the bases on which seasonal spray information relative to the timing of applications is given to orchardists. This information, together with the forecasts of weather conditions, gives the fruit-grower a chance of making spray applications in advance of many critical periods and thus gain maximum protection for his crop of fruit.

#### CONTROL OF THE APPLE SCAB

The review of the life-history of the fungus points out two main sources of infection: (a) ascospores from the old leaves, and (b) conidia from the current season's spots. It is therefore necessary to prevent either the formation



of the ascospores or to protect the foliage and fruit from being infected by them.

No satisfactory commercial method has been found for treating the old leaves, to prevent the formation of the winter spores. Ploughing under or preferably burning these, where practical, aids in the control of the disease. If twig lesions are severe, these should be pruned out early in the season.

Spray or dust fungicides are applied to the plant as a protection, not as a cure for injury already done. Therefore, in order to be effective, all control measures must be taken before the injury or disease commences to show on the plant. The only way this can be done is to protect the growing leaves and fruit as soon after they are formed as possible. For these reasons the following general times of application are fundamental to control.



FIG. 3—Apple scab. The secondary form which is commonly observed in the orchard.

**FIRST APPLICATION.**—When the leaf buds are in the “green-tip” or “mouse-ear” stage of development.

**SECOND APPLICATION.**—When the flower buds are showing pink and are separating from the clusters.

**THIRD APPLICATION.**—When the petals have mostly fallen.

**FOURTH APPLICATION.**—From ten to fourteen days after the third application.

**FIFTH AND LATER APPLICATIONS.**—These may be made every ten to fourteen days after the fourth application to protect the developing fruit during periods of prolonged wet weather. Dusts may be applied on wet foliage, but sprays should be applied only on dry foliage.

**SPECIAL APPLICATIONS.**—During seasons of slow development when there appears to be a likelihood of more than two weeks between the times for the



regular applications, special sprays or dusts should be applied. If it is considered necessary to spray during full bloom no poison should be used. A special application of fungicide about a month or six weeks before harvest is found to materially protect the fruit from late scab infections as well as sooty blotch and other diseases which may appear in storage.

### MATERIALS TO BE USED

A favourite question among fruit-growers is: "What shall I use, spray or dust?" Experience has shown that either method is effective when properly and thoroughly applied. Good commercial control of apple scab can be obtained by proper and timely use of any standard fungicide, whether in solution or dust.

Four of the most popular spray- and dust-calendars are given in this pamphlet. Modifications may be necessary for local conditions.

1. **LIME-SULPHUR.** Concentrated lime-sulphur (specific gravity about 1.32) 1 gallon to 40 gallons of water, making a solution of about 1.008 sp. gr., may be used for the first and second applications. A solution as weak as one to sixty or sp. gr. 1.005 may be used for the third, fourth, and later applications. The specific gravity of lime-sulphur should always be tested with a hydrometer before making dilutions. This may vary from 1.24 to 1.33. In order to determine the correct dilution, divide the figures after the decimal point in the concentrate by the figures after the decimal point in the required solution. Thus if the concentrate is 1.32 and the required solution is 1.008, divide the .32 by .008. The result is 40. That is 1 gallon of the concentrate should be diluted with water to make 40 gallons of a 1.008 strength solution.

2. **BORDEAUX.** Bordeaux mixture is more generally used in Eastern Canada at the strength of 3-10-40 (3 pounds of copper sulphate, 10 pounds of hydrated lime, and 40 gallons of water). This may be used for all but the calyx or third regular application. For this spray, wettable sulphur (30 pounds to 100 gallons water) or lime-sulphur 1 to 50 (1.006 sp. gr.) or 1 to 60 (1.005 sp. gr.) is preferred as the bordeaux causes russetting.

With both these sprays, lead arsenate powder may be used at rates of 1 to 3 pounds to 40 gallons of spray, or calcium arsenate at rates of  $\frac{1}{2}$  to 2 pounds to 40 gallons of spray.

3. **COPPER DUST.**—A dust mixture composed of 12 pounds dehydrated copper sulphate, 8 pounds arsenate of lime, 80 pounds hydrated lime or 10 pounds arsenate of lead and 78 pounds hydrated lime in place of the arsenate of lime may be used for the first, second, and fourth applications. Sulphur dust, 90-10 sulphur-lead arsenate should be used for the third application to prevent russetting.

4. **SULPHUR DUST.** Sulphur-lead arsenate dust mixture of 90-10 strength may be used for all applications.

It is generally found that applications of dust should be made more frequently than sprays. When special applications are desirable late in the season, any good quality of dusting sulphur, without poison, is satisfactory. In seasons having a dry summer the spray residue is likely to adhere to the fruit and may affect its salability. A sulphur dust does not leave a noticeable residue on the fruit and will give very good protection from late scab infections as well as other diseases.

